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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

FEE TRANSMITTAL for FY 2004

Effective 10/01/2003. Patent fees are subject to annual revision.

☐ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT **($) 330.00**

Complete if Known	
Application Number	**09/942,926**
Filing Date	**August 31, 2001**
First Named Inventor	**George M. JOYNES**
Examiner Name	
Art Unit	
Attorney Docket No.	**3036/50371**

METHOD OF PAYMENT (check all that apply)

☒ **Check** ☐ **Credit Card** ☐ **Money Order** ☐ **Other** ☐ **None**

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Deposit Account Number 05-1323

Deposit Account Name Crowell & Moring LLP

The Director is authorized to: (*check all that apply*)

☐ Charge fee(s) indicated below ☒ Charge any deficiency or credit any overpayments to the deposit account of the undersigned. Attorney Docket No. 038819.50371

☐ Charge any additional fee(s) during the pendency of this application.

☐ Charge fee(s) indicated below, **except for the filing fee to the above-identified deposit account.**

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1001	770	2001	385	Utility filing fee	
1002	340	2002	170	Design filing fee	
1003	530	2003	265	Plant filing fee	
1004	770	2004	385	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	
				SUBTOTAL (1)	

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

	Extra Claims		Fee from below	Fee Paid
Total Claims	-20** =	x		=
Indep. Claims	-3** =	x		=
Multiple Dependent				=

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	86	2201	43	Independent claims in excess of 3
1203	290	2203	145	Multiple dependent claim, if not paid
1204	86	2204	43	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) $

***or number previously paid, if greater; For Reissues, see above.*

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge – late filing fee or oath	
1052	50	2052	25	Surcharge – late provisional filing fee or cover sheet	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examination action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	420	2252	210	Extension for reply within second month	
1253	950	2253	475	Extension for reply within third month	
1254	1,480	2254	740	Extension for reply within fourth month	
1255	2,010	2255	1,005	Extension for reply within fifth month	
1401	330	2401	165	Notice of Appeal	
1402	330	2402	165	Filing a brief in support of an appeal	330.00
1403	290	2403	145	Request for oral hearing	
1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive – unavoidable	
1453	1,330	2453	665	Petition to revive – unintentional	
1501	1,330	2501	665	Utility issue fee (or reissue)	
1502	480	2502	240	Design issue fee	
1503	640	2503	320	Plant issue fee	
1406	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	770	2809	385	Filing a submission after final rejection (37 CFR § 1.129(a))	
1810	770	2810	385	For each additional invention to be examined (37 CFR § 1.129(b))	
1801	770	2801	385	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid **SUBTOTAL (3) ($)**

330.00

SUBMITTED BY				Complete (*if applicable*)	
Name (Print/Type)	Gary R. Edwards	*Registration No. (Attorney/Agent)*	31,824	*Telephone*	202-624-2500
Signature	Gary R Edwards			*Date*	May 17, 2004

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	: 09/942,926	Confirmation No.	: 8942
Applicant	: George M. JOYNES		
Filed	: August 31, 2001		
TC/A.U.	: 2856		
Examiner	: Andre K. Jackson		
Docket No.	: 3036/50371		
Customer No.	: 23911		
Title	: Improvements in or Relating to Fluid Flow Sensors and Leak Detection Systems		

APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

May 17, 2004

Sir:

Pursuant to the Notice of Appeal filed March 17, 2004, Appellant herewith submits herewith its appeal brief and the appropriate fee in accordance with the provisions of 37 C.F.R. §§1.17(f) and 1.192.

I. REAL PARTY IN INTEREST

This application has been assigned by the inventor to Roke Manor Research Limited, a company having an office or place of business at Romsey, Hampshire, United Kingdom. Accordingly, the real parties in interest to the present appeal are the named inventor and Roke Manor Research Limited.

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to the Appellant, to Appellant's legal counsel or to the assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

Claims 1-5, 7-10, 13 and 15-17 are currently pending in this application, Claims 6, 11, 12 and 14 having been cancelled. By this appeal, Appellant seeks review of the final rejection of all of Claims 1-5, 7-10, 13 and 15-17 on prior art grounds.

IV. STATUS OF AMENDMENTS

Four amendments have been submitted in respect of the present application. A preliminary amendment filed August 31, 2001, and subsequent amendments dated March 4, 2003 and August 5, 2003 have been entered. In addition, on December 12, 2003, Appellant submitted a Response to Final Office Action, which included no revisions to either the specification or claims. It did have attached thereto, however, a proposed drawing change responsive to an objection to the drawings contained in the Office Action dated October 17, 2003.

In the Advisory Action dated March 4, 2004, the Examiner indicated that the "proposed amendment" would not be entered, but gave no reasons for refusing to enter the drawing correction. Accordingly, concurrently herewith, Applicant has submitted a fourth amendment, once again attaching the proposed drawing correction, and amending the specification correspondingly at page 17, line 15 to incorporate a reference to the comparator 14a. For the purposes of the present appeal, Applicant has assumed that the latter amendment has been entered.

V. SUMMARY OF THE INVENTION

The present invention is directed to a method and apparatus for detecting leakage conditions in fluid conducting pipes. In particular, Appellant's experiments, as summarized in the specification at page 5, line 20 through page 13, line 19, have established that it is possible to detect the occurrence of a leak by analyzing the frequency spectrum of the resulting noise which is propagated in the pipes. Therefore, according to the invention, as described in the specification at page 5, lines 3 through 19, and depicted in Figure 1 of the drawing, a sensor 12 is used to detect vibrations which are occurring in a pipe, and an output signal from the sensor is supplied to a processing unit 14. The latter signal is then segmented to at least two spectral bands, the amplitudes of which are compared with predetermined values to determine a flow rate, as described in the specification, for example, at page 2, lines 19-24. For this

purpose, the processing unit 14 includes a comparator 14a that makes comparisons between sensor data and various input data, as indicated, for example, at page 17, lines 12-19. (As recited in Claim 1 of the present application, the presence of a leak is determined by comparing the amplitudes of the spectral bands with predetermined values.)

VI. ISSUES

The issues presented by this appeal are:

1. Whether Claims 1-3, 7, 8, 13 and 15 are unpatentable under 35 U.S.C. §102(b) as anticipated by Kiewit (U.S. Patent No. 5,040,409);
2. Whether Claims 5, 10 and 17 are unpatentable under 35 U.S.C. §103(a) as obvious over Kiewit in view of Roy (GB 2 335 041); and
3. Whether Claims 4, 9 and 16 are unpatentable under 35 U.S.C. § 103(a) as obvious over Kiewit in view of Braathen et al (U.S. Patent No. 6,305,233).

VII. GROUPING OF THE CLAIMS

The present application contains three independent claims (Claims 1, 7 and 13). Appellant submits that each of these independent claims is allowable

for the reasons set forth hereinbelow, and that all other claims currently pending in this application, which depend directly or indirectly from one of the three independent claims are allowable as well. Accordingly, for the purpose of the present appeal, Claims 1-5, 7-10 and 13-17 may be grouped together.

VIII. ARGUMENT

The primary Kiewit reference discloses a system in which two frequencies are sensed in order to detect a "catastrophic" leak in a sprinkler system, such as may be caused by a sprinkler nozzle being broken off. For this purpose, Kiewit provides a signal transducer 56, from which an electrical signal 66 is fed to low pass and high pass filters 72,74, as illustrated in Figure 3. See specification at Column 4, lines 34-53.

As discussed at Column 4, line 65 through Column 5, line 28, the output of the low pass filter is used to detect a flow of water in a particular zone of a multizone sprinkler system. As noted for example, at Column 5, lines 9-12, the digitized representation of the average low frequency power 88 is compared with a predetermined threshold value to confirm that water is in fact flowing through the pipes. If the average low frequency acoustic power does not exceed the predetermined threshold value (such as in the case of a failure of the water supply system), an error message is generated.

After it has been determined that water is in fact flowing in the pipes, based on the low frequency acoustic power, "the ratio of the average low frequency acoustic power 88 to the average high frequency acoustic power 90 is then compared with a second predetermined threshold value". If such ratio exceeds the predetermined threshold, an alarm is triggered, and a shutdown command is sent to the system.

Claim 1 of the present application, as amended, differs from the Kiewit reference in the manner in which a leak is detected. In particular, Claim 1 recites that such determination is made by comparing the amplitudes of the respective spectral bands with predetermined values to determine a flow rate. As can be seen from the above brief summary of the Kiewit apparatus, the process for determining a leak in Kiewit comprises comparing power at one frequency with a threshold, and then comparing the ratio of the high and low frequency power values to a second threshold. The methodology therefore differs.

The difference, moreover, is important in the overall context of Kiewit, as compared to the present invention. That is, Kiewit is concerned with the sprinkler system which detects "catastrophic" leaks, in which massive amounts of water may be expected to flow. By contrast, the present invention is directed

to a system which is capable of detecting leaks at low flow rates. (See, for example, the discussion of Figure 2 at starting at page 6, line 6 of the specification; and also page 11, line 11 *et seq.*) For this purpose, as specified in Claim 1, and as discussed in detail in the specification, the present invention compares the respective amplitudes of sensed vibrations in at least two spectral bands with respective predetermined threshold values. For the reasons discussed in the specification, this technique can in fact be used to detect leaks at low flow rates.

With regard to the limitation in Claims 1, 7 and 13 that a comparator compares "the amplitudes of spectral bands with predetermined values to determine the presence of a leak", the Advisory Action mailed March 17 states that this recitation is disclosed in Kiewit, noting that the claim language is "concerned with comparing amplitudes with predetermined values". This, however, is not a complete characterization of the limitations of Claim 1, for example, which recites segmenting the sensed vibrations into at least two spectral bands and comparing the amplitudes "of the spectral bands" with predetermined values to determine a leak condition. As correctly noted in Appellant's comments accompanying the December 12, 2003 response, the Kiewit method differs. In particular, Kiewit uses a particular amplitude at a particular frequency, as well as a ratio of amplitudes in order to trigger an alarm indicating a high flow rate. The comparison of a "ratio" is not the same as comparing the

amplitudes of spectral bands with predetermined values. Rather, a "ratio" is a pure number. Accordingly, Kiewit fails to teach or suggest segmenting the sensed vibrations into at least two spectral bands and comparing amplitudes of the respective spectral bands with predetermined values, as recited in Claims 1, 7 and 13.

To summarize, Kiewit uses a different detection technique for a different purpose, utilizing a ratio of amplitudes in order to trigger an alarm indicating a high flow rate. Because of this arrangement, Kiewit may give a false alarm because of a high flow rate condition caused, for example, by a flushing toilet cistern, which is of course not a problem in a sprinkler system, but is a situation resolved by the present invention. In short, the apparatus according to the present invention is concerned with monitoring of a system that requires a greater refinement of detection in order to avoid false alarms.

The Roy reference (GB 2 335 041) has been cited as disclosing a leak detection system which includes use of a hydrophone. Moreover, the Braathen et al reference has been cited only as disclosing a digital speed determination in ultrasonic flow measurements which utilizes a sensor that includes a PVDF film. Accordingly, it is apparent that neither of the latter references teaches or

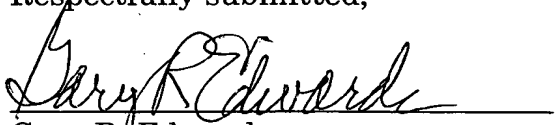
suggests those features of independent Claims 1, 7 and 13 which are discussed above, and which are missing in Kiewit.

IX. CONCLUSION

For the reasons set forth hereinabove, Appellant respectfully submits that Claims 1-5, 7-10, 13 and 15-17 are patentable over the references of record, taken either singly or in combination. Accordingly, Appellant respectfully requests that the Board reverse the final rejection of these claims and allow the present application.

This Appeal Brief is accompanied by a check in the amount of $330.00 in payment of the required appeal fee. This amount is believed to be correct, however, the Commissioner is hereby authorized to charge any deficiency, or credit any overpayment, to Deposit Account No. 05-1323 (Docket #3036/50371). A triplicate copy of this Appeal Brief is attached.

Respectfully submitted,



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APPENDIX

Claim 1. A method of determining the presence of a leak condition in a fluid system, comprising:

sensing by a sensor vibrations induced in said fluid system by passage of the fluid through said leakage;

segmenting by a segmentor the sensed vibrations into at least two spectral bands; and

comparing amplitudes of the spectral bands with predetermined values to determine a leak condition.

Claim 2. A method according to claim 1, further comprising attaching a sensor to the fluid system to obtain data therefrom indicative of fluid flow therethrough.

Claim 3. A method according to claim 2, wherein the sensor includes a piezo-electric material.

Claim 4. A method according to claim 3, wherein the sensor includes a PVDF film.

Claim 5. A method according to claim 2, wherein the sensor comprises one of a strain gauge, geophone or hydrophone.

Claim 7. Apparatus for determining the presence of a leakage from a fluid system, comprising:

a vibration sensor for sensing vibrations induced in said fluid system by passage of the fluid through said leakage;

a segmentor for segmenting the sensed vibrations into at least two spectral bands; and

a comparator for comparing amplitudes of the spectral bands with predetermined values to determine a leak condition.

Claim 8. Apparatus as claimed in claim 7 wherein the sensor includes a piezo-electric material.

Claim 9. Apparatus as claimed in claim 8 wherein the sensor includes a PVDF film.

Claim 10. Apparatus as claimed in claim 8 wherein the sensor comprises one of a strain gauge, geophone or hydrophone.

Claim 13. A leakage detection system for use in a fluid carrying system, said leakage detection system comprising:

at least one sensor mountable to the exterior of a pipe of the fluid carrying system, said sensor comprising a vibration sensor for measuring vibrations in the pipe caused by fluid flow in the pipe and providing output signals indicative of the vibrations;

a processing unit for receiving signals from the at least one sensor and for comparing the received signals with reference data to determine the presence of a leak;

a segmentor for segmenting the sensed vibrations into at least two spectral bands; and

a comparator for comparing the amplitudes of the spectral bands with predetermined values to determine the presence of a leak.

Claim 15. Apparatus as claimed in claim 13 wherein the sensor includes a piezo-electric material.

Claim 16. Apparatus as claimed in claim 15 wherein the sensor includes a PVDF film.

Claim 17. Apparatus as claimed in claim 15 wherein the sensor comprises one of a strain gauge, geophone or hydrophone.